

5

SPECIFICATION

TITLE

Device for heating foodstuff with hot air

10 TECHNICAL FIELD

The present invention relates to an oven for heating foodstuff, in particular french fries, by means of hot air circulating in a substantially closed circle, wherein circulation of the air is forced, preferably by a fan or a blower. It in particular relates to an oven which is suited for heating individual portions or a small number of portions within a very short
15 amount of time.

BACKGROUND OF THE INVENTION

Classically, french fries are prepared using a bath of hot oil, which leads on the one hand to a crispy surface of the french fries and which and the other hand reduces the
20 moisture within the french fries to the desirable amount. The french fries may be provided as raw potato sticks, but may also be provided as precooked potato sticks.

Such cooking of french fries has a number of drawbacks, one of which being that the heating of the bath of hot oil requires substantial energy and time and in particular if not used regularly, the storage of such a bath of oil is problematic. Furthermore, such a
25 bath of hot oil gives rise to fumes, which have to be eliminated by means of expensive ventilation etc. Additionally, such a bath of hot oil has to be exchanged regularly, so only if used intensely and regularly, keeping of such a bath is economic and at the same

time leads to high-quality french fries.

Therefore, there is a number of products on the market, eliminating the need for a bath of hot oil. On the one hand there is precooked and pre-fried french fries, which can be heated in conventional ovens. However, due to the moisture in the french fries which cannot escape in a conventional oven, and due to close contact between individual potato sticks, the quality of such heated french fries is generally quite low in terms of crispiness and moisture.

Several devices for heating french fries trying to eliminate the above-mentioned problems have been proposed. For example there is US 5,690,018 disclosing an oven using heat radiation. US 5,445,073 discloses an oven in which the french fries are heated by a stream of hot air which is guided through the french fries from the bottom and at least partially lifts and moves the french fries during the heating process. Also WO 97/37575 discloses an oven in which the stream of hot air moves the french fries, but in this case the movement is additionally supported by a vibration of the container in which the french fries are stored.

Problematic in the case of all these ovens according to the state-of-the-art is the fact that if the french fries are not moved, normally due to the contact between individual potato sticks the heating is not efficient enough and leads to unheated areas, and that if the french fries are moved there is a high risk of damaging at least some of the french fries. So there is a need for a device for heating individual portions or small numbers of portions of french fries or more generally foodstuff comprising individual small units leading to an efficient and very quick overall heating of the french fries without destroying the french fries, and providing optimum taste qualities like crispiness, moisture, etc..

SUMMARY OF THE INVENTION

The objective problem underlying the present invention is therefore to provide an improved device for heating foodstuff, in particular french fries or some other foodstuff being formed of a limited number of individual pieces or parts. So apart from french

fries also spring rolls, potato croquettes and the like shall be heatable by such device. In more detail, the present invention relates to the improvement of an oven for heating foodstuff, in particular french fries, by means of hot air circulating in a substantially closed circle, wherein circulation of the air is forced, preferably by a fan or a blower.

- 5 The present invention solves the above problem in that the foodstuff is contained in at least one receptacle at least one or two of the walls of which is at least partially penetrable to the circulating hot air, in that the receptacle is at least partially enclosed towards its penetrable wall(s) by walls of a container, wherein there is a spacing between the respective walls of the receptacle and the walls of the container, and in that
- 10 hot air is entering the receptacle and/or the container substantially from an upper side. Furthermore, in the region into which the hot air is entering the receptacle and/or the container, the side wall of the container is inclined with respect to a horizontal plane by a first angle α and a corresponding penetrable side wall of the receptacle is inclined with respect to said horizontal plane by a second angle β , wherein the first angle α is
- 15 smaller than 90° and larger than the second angle β .

The object of the present invention is therefore a device according to claim 1, as well as a method according to claim 30.

- The key feature of the invention is therefore the fact that hot air is entering the region in which the foodstuff is to be heated from an upper side, impinges onto the tilted side wall
- 20 of the container, the tilt angle of which is smaller than 90° , and is thus deviated into the receptacle through the penetrable tilted side wall of the receptacle correspondingly being guided through the foodstuff kept in the receptacle. Due to the fact that the tilt angles α and β are different from each other, and due to the fact that α is larger than β , there is provided a region between the receptacle and the container which opens up
- 25 towards the bottom of the container and/or the receptacle. Therefore a very efficient and homogeneous distribution of the flow of hot air not only in the interspace between the walls of the receptacle and the container but also within the receptacle can be achieved. It proves to be advantageous to provide a planar tilted wall of the container as well as of the receptacle. When mentioning horizontal orientation, the horizontal plane
- 30 is defined if the device is put in normal operation onto some horizontal table or the like.

Correspondingly, if the term vertical is used for orientation it is vertical to this horizontal plane. The air may enter the interior of the container either directly into the space between the tilted side wall of the receptacle and the tilted side wall of the container, but it is also possible that at least partially the hot air enters the container by first passing through a part of the tilted side wall of the receptacle and subsequently flowing into the space between the tilted side wall of the receptacle and the tilted side wall of the container. Preferentially, an (imagined) intersection line between the tilted side wall of the receptacle and the tilted side wall of the container is aligned substantially horizontally. Typically, the receptacle as well as the container is of elongate shape, i.e. lateral side walls on the upper side of the receptacle are longer than the tilted sides and a side opposite to the tilted side. The hot air entering the receptacle and/or the container first enters in the region of the space between the two tilted walls, passes through the receptacle and the foodstuff contained therein, and then exits towards the upper side of the receptacle back into a heating section of the oven. So in case of an elongate receptacle, the hot air enters from the top on one side in a substantially vertical direction then turns around, passes the foodstuff, and is diverted upside again to exit the receptacle in a substantially vertical direction. A closed circle of the air can thus be provided, and smelly fumes can be avoided.

Thus, in a first preferred embodiment of the present invention, the oven according to the invention is characterised in that hot air is entering the receptacle and/or the container substantially from a vertical direction perpendicular to said horizontal plane, and preferentially that after having entered and passed through the foodstuff the air exits the receptacle and/or the container again towards the upper side, preferentially in a vertical direction.

According to another preferred embodiment of the present invention, the device is characterised in that said first angle α is about twice as large as said second angle β . Typically, the first angle α is smaller than 80° , preferentially smaller than 75° , even more preferentially in a range between 70 and 60° . The second angle β can be chosen to be smaller than 50° , preferentially smaller than 45° , even more preferentially in a range between 40 and 30° .

Another preferred embodiment of the present invention is characterised in that the receptacle has an opening towards its upper side, and in that preferentially all the side walls as well as the bottom wall are penetrable to the hot air. If these side walls are well spaced from the walls of the container, a very efficient flow and distribution of hot air is allowed, thus leading to a very efficient and homogeneous heating process. Particularly good results can be achieved if furthermore the receptacle has walls made of a grid or mesh, preferentially made of metal, wherein preferentially there is a horizontal bottom grid, a vertical backside grid and two vertical side grids aligned substantially parallel to each other, as well as a tilted front grid. Alternatively, the walls can be made of perforated material like perforated metal plates.

If, as preferred, at least parts of the hot air entering the region first pass a gap between the tilted wall of the receptacle and the tilted wall of the container, the receptacle furthermore comprises a horizontal grid portion adjacent to the tilted front grid substantially in the plane of the opening towards the upper side of the receptacle. This horizontal grid portion is then first penetrated prior to entering the region between the two tilted walls.

Since the foodstuff normally lies more densely towards the bottom side of the receptacle, particularly homogeneous and effective ventilation of this region is very important. To make sure that this effectively takes place, the bottom wall of the container is preferentially spaced from the bottom grid of the receptacle by e.g. 1 centimetre. To keep this distance well-defined, it is therefore advantageous to provide the receptacle furthermore with a nose for keeping its bottom grid in a defined spacing from the bottom wall of the container. This nose or protrusion is preferentially made of the same material as the side walls of the receptacle, i.e. may be an extension made of metal grid or the like.

According to another preferred embodiment of the present invention the container comprises a horizontal bottom wall, a vertical backside wall and two vertical side walls aligned substantially parallel to each other, as well as a tilted front wall, all of which are not penetrable to the hot air and which are preferentially made of coated or uncoated metal, but also synthetic material like heat-resistant plastic or the like is possible. In this

case, it may be advantageous to design the receptacle such that it fits into the container such that hot air entering the container and/or the receptacle at least partially passes a vertical grid portion which is part of the receptacle, which is preferentially aligned adjacent to the tilted side grid of the receptacle and is aligned substantially vertically.

5 For particularly easy operation it is possible, according to another preferred embodiment, to provide a slidable insert, into which the receptacle is inserted, and which can be shifted into the oven and thus into the stream of hot air of the oven. So in a typical mode of operation, the slidable insert into which the container is removably incorporated is drawn out of the oven, the receptacle filled with foodstuff is inserted
10 into the container from the top and thus into this part of the insert, and the whole insert is subsequently shifted back into the main body of the oven, thus moving it into the circulating hot air. For easy cleaning of the container (normally small bits and parts of the french fries as well as oil and water drop down through the permeable side walls of the receptacle during the heating process) the container can be taken out of the insert
15 and cleaned separately.

According to another preferred embodiment of the present invention, heating of the air takes place in a heating cavity located upstream of the fan. Heating elements like heating coils may be provided in this heating cavity, either directly or in particular compartments such that transfer of heat only takes place along walls. Preferentially, the
20 unit for heating as well as actuating the air is located above the compartments, in which the receptacle and the container are located.

Preferentially, substantially immediately upstream of the section for heating the hot air and/or substantially immediately upstream of the receptacle and/or the container there is provided filtering means for the air. These filtering means may be perforated or mesh-
25 like structures made of metal or synthetic material, preferably additionally retaining condensed water present in the circulating hot air. The filtering means can be a semi-permeable membrane permeable to air and steam but impermeable to condensed water. Possible is for example a GoreTex® membrane.

The receptacle may be designed to have a volume in the range of 1 – 2 litres. Preferably
30 the volume for taking up pre-fried or precooked convenience food amounts to about 1.7

litres. Generally speaking, the receptacle is designed to take up one portion or several portions of the foodstuff, wherein typically one portion of pre-fried French fries amounts to normally less than about 400 g and may e.g. be in the range of 80 - 150 g. For other convenience food (e.g. rösti, spring rolls) also portions of up to 700 g may be heated in such a receptacle, whereby longer heating times may have to be put off with. Such a receptacle for one portion can be heated up ready to eat in a time-span in the range of or less than one minute.

The present invention furthermore relates to a method for heating foodstuff by means of hot air in a substantially closed circle, preferably using an oven as described above. The method is preferentially characterised in that the circulating hot air is heated to a temperature in the range of 180-250° C, preferentially heating a portion of french fries within a time-span in the range of one minute. Normally, during the heating process the foodstuff is not substantially moving within the receptacle, thus avoiding (partial) destruction of the foodstuff. Particularly easy operation is made possible if the heating process is initiated after having read a barcode e.g. provided on the package of the foodstuff to be heated, preferentially indicating particular heating conditions adapted to the foodstuff contained in the package.

Further embodiments of the present invention are outlined in the dependent claims.

SHORT DESCRIPTION OF THE FIGURES

In the accompanying drawings preferred embodiments of the invention are shown in which:

figure 1 shows a schematic cut through an oven according to a preferred embodiment of the invention;

figure 2 shows detailed perspective views of individual elements of an oven according to a preferred embodiment of the invention, wherein a) shows the basket for the foodstuff, b) the container for taking up the basket, c) the sliding insert for moving the foodstuff into the oven, e) the housing part as well as the upper part of the oven without covering elements; and

figure 3 shows a schematic cut through an oven according to a preferred embodiment of the invention indicating the circulating flow of air.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

5 Referring to the drawings, which are for the purpose of illustrating the present preferred embodiments of the invention and not for the purpose of limiting the same, figure 1 shows a schematic cut through an oven 1 according to a first preferred embodiment of the present invention. The direction of the cut is parallel to the front side of the oven 1.

The oven 1 comprises an upper part, in which the heating cavity 8 as well as the means
10 for the propulsion of the stream of air is located. Propulsion of the air is achieved by a fan 20, which is located in a housing 7. The fan 20 is energised by a motor 6. Such a motor normally has a power in the range of 195 Watt leading to an effective circulation of air of about 200m³/h at a static pressure of 500 Pa. In conjunction with the regulated air temperature at the exit of the blower of in the range of 195 to 205 °C this leads to
15 heating of the food within about 2 minutes. If the machine is to be designed in other dimensions for example for taking up more portions, the power as well as the circulation have to be scaled up accordingly. The axis of the motor is arranged parallel to the front side of the oven.

In the lower part of the oven there is located a container 4, which comprises a tilted
20 front wall 4a on the fan side of the oven, a bottom wall 4b, two lateral side walls 4c parallel to the front side of the oven, and one backside wall 4d. The bottom wall 4b is arranged horizontally, and the tilted wall 4a encloses an angle α with the horizontal plane which is different from 90°. In this particular case the angle α is 66°. On the top edges of the tilted front wall 4a, the lateral side walls 4c and the backside wall 4d there
25 is provided salient horizontal borders 4e, allowing to fix or hold the container 4 within an insert. The walls of the container are made of a heat resistant material, like for example metal, coated metal, heat resistant polymeric materials, etc. In this particular embodiment, INOX was chosen as the material for the walls of the container 4.

Within the container 4, there is located a basket 2, into which the foodstuff is to be put

for heating. The basket 2 comprises a tilted front wall 2a on the fan side of the oven, a bottom wall 2b, two lateral side walls 2c parallel to the front side of the oven, and one backside wall 2d. The bottom wall 2b is arranged horizontally, and the tilted wall 2a encloses an angle β with the horizontal plane which is different from 90° and in any case smaller than the above-mentioned angle α of the container 4. In this particular case the angle β is 35° . The walls of the basket 2 are all permeable to air, and are made of a grid of metal wires (INOX) with a thickness of 0.8 mm, and with a spacing of 8 x 8 mm.

Due to the different tilt angles of the wall 4a of the container and of the grid 2a of the basket 2 there is a region or empty space 12 which becomes wider towards the bottom of the container. The air entering this region 12 from the top gets well distributed around the basket 2 due to this shape of the empty space 12. The basket 2 furthermore comprises a nose 26, which makes sure that the basket 2, if inserted into the container 4 does not touch the bottom of the container, i.e. that there remains an empty space 13 between the two bottom walls 2b and 4b. This empty space 13 furthermore improves homogeneous and efficient circulation of the air around the basket and homogeneous entry into the basket and through the foodstuff located in the basket.

Arrows indicate the dimensions chosen for individual parts of the oven 1, so the length a of the heating cavity 8 is 205 mm, the height b of the heating cavity is 145 mm, the width d of the channel for entry of air into the heating cavity 8 is 130 millimetre, the height e of the housing for the fan is 265 mm, the width f of this housing is 106 mm, and the width g of the room for the motor is 130mm.

The two tilted walls 2a and 4a are not arranged adjacent to each other, but there remains a spacing in the top region. In this spacing there is provided a horizontal grid portion 3 of the basket 2, such that if hot air is entering from the top in this region, it passes this horizontal grid portion.

In figure 2 perspective views of individual parts of the oven are given. Figure 2a shows the basket 2. It can be seen, that there is provided a handle 14, made of a bent thick metal wire, and which, if the basket 2 is inserted into the container 4 and into the insert 16 in the oven 1 sticks out of the oven. It allows easy handling of the basket for filling

it with foodstuff and inserting and removing the basket into and from the oven. It may be slightly bent downwards to facilitate handling, and extends approximately 15 to 20 cm away from the edge of the basket 2. The basket has a depth of 90 mm, and if for the angle β a value of 35° is chosen, the bottom part of the basket has a length of 60 mm. The basket furthermore has a height of 140mm and a length at its top edge of 160 mm. The horizontal grid portion 3 has a length of approximately 35mm.

Figure 2b) shows the container 4 if removed from the insert 16. In this view it can be seen that it comprises a horizontal border 4e along the top edge, with one recess for the handle 14 of the basket.

Figure 2c) shows the insert 16, which comprises a front wall of or front plate 18 as well as two lateral track rails 17 as means for easy shifting of the insert into and out of the oven 1. It furthermore comprises an opening 19 on the top, adapted to take up the container 4 such that its border 4e comes to lie on top of the edge portion of the insert 16 thus supporting the container 4 in the insert 16.

The lateral side walls 4c of the container are spaced from each other by 92mm (depth), the height of the container is 155mm and its length on the bottom side is 230 mm. The opening on the top has a size of 298 x 92 mm. The angle α is chosen to be 66° . The border 4e has a width of approximately 10-15 mm.

Figure 2 d) shows a view of the lower housing of the oven and as well as of the top parts of it. In the lower part there is provided a basically rectangular box into which the insert 16 fits and can be shifted into and out of by means of movable rails 15. On the top part one can see that the heating cavity on the left side is provided with an opening 9 for entry of the air having passed the foodstuff region into the heating cavity 8. On the right side of the top portion of the oven 1 there is provided the housing 7 for the fan 20, as well as the motor 6. The housing 7 of the motor is adapted to take in the air from the heating cavity 8 and to blow it into the lower part via an exit 11.

Figure 3 shows the principal air flows in an oven according to another preferred embodiment. In the heating cavity 8 the hot air gets heated by means of heating elements 21 along which or through which the hot air is flowing. The surface of these

heating elements may have temperatures of about 500° C, while the heating elements 21 are regulated to give rise to a temperature of the air in the range of 200°C. This choice was found to lead to an optimal heating of the foodstuff, but also for user safety reasons higher temperatures should be avoided. There is provided two temperature sensors 27 for this regulation, one safety sensor 27 basically in the centre of the cavity 8, and one 5 27 for the actual regulation of the heating elements 21 is located in the exit region of the fan or blower 20. In particular the heating element 21 immediately downstream of the receptacle (region of arrow 23 in Figure 3) is adjusted to have a high surface temperature in the range of 500° C such as to ensure burning (pyrolysis) of grease 10 components present in the circulating hot air and to keep them away from the blower 20. This heating element correspondingly partially acts as a filter. The heating elements 21 can be provided on the entrance side as well as on the exit side of the heating cavity 8 or both. Downstream of the heating cavity 8 there is located the fan 20, which blows the hot air 22 through a filter 25. The length k of this opening for the filter 25 is 15 approximately 70 mm. The hot air enters the region of the foodstuff 28 on the right side of the basket 2 and/or of the container 4 and partially flows around the basket 2 entering it through all the permeable walls 2a-2d from all sides. It subsequently exits as colder air 23 the region of the foodstuff vertically in another direction, first passes a second filter 24 and then enters the heating cavity 8. The length h of the second filter 24 is 127 20 mm.

The filters 25 and 24 can be metal wire meshes, wherein the metal wires (INOX) have a thickness of 0.5 mm and are spaced from each other by 1.5 mm. Alternatively, one or both of these filters can be substituted or supplemented by filters additionally eliminating condensed water from the circulating hot air. This is for example possible 25 by filters with semi-permeable membranes made of polytetrafluoroethylene, like e.g. available under the trade name GoreTex®.

LIST OF REFERENCE NUMERALS

	1	oven
	2	basket
	2a	tilted front grid of 2
5	2b	bottom grid of 2
	2c	side grid of 2
	2d	backside grid of 2
	3	horizontal grid portion on 2
	4	container
10	4a	tilted front wall of 4
	4b	bottom wall of 4
	4c	side wall of 4
	4d	backside wall of 4
	4e	border of 4
15	5	frame of 1
	6	motor
	7	housing for fan
	8	heating cavity
	9	entry into 8
20	10	exit from 8, entry into 7
	11	exit from 7
	12	empty space between 2a and 4a
	13	empty space between 2b and 4b
	14	handle of 2

- 15 rail for insert
- 16 insert
- 17 Track rails on insert
- 18 front plate of insert
- 5 19 opening in 16 for 4
- 20 fan
- 21 heating elements
- 22 hot air entering food area
- 23 "cool" air exiting food area
- 10 24 metal grid
- 25 metal grid
- 26 nose on 2
- 27 temperature sensor
- 28 foodstuff, French fries
- 15
- α inclination angle of 4a
- β inclination angle of 2a